**Supplementary Materials**

**Analysis branch 1 – alternative ANOVA**

In analysis branch 1, we observed that foraging during the two order conditions differed only in terms of adjustments in the number of mid-rank captures in the downturn environment. Given that mid-rank captures involve two invader identities, we ran an additional ANOVA to see if similar results emerged, replacing the three level variable (hi, intermediate, low), with a four level variable that mapped onto the reward / cost combination of the four different invader identities (hi/low, hi/hi, low/low, low/hi). This ANOVA again reported a significant three-way interaction between , and (. Contrasting mean capture rates between BD and DB, for the eight levels of the \* interaction, we fist observed significantly higher capture of hi/hi invaders in the downturn environment for order DB, relative to BD vs. , both . In addition, we observed significantly higher capture of low/low invaders in the downturn environment for order DB, relative to BD vs. , both . As with the original ANOVA, no other contrasts reached statistical significance. Foraging during the two order conditions accordingly differed in terms of increased capture rate of both mid-rank invader identities in the downturn environment.

**Analysis branch 1 - full model results**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  | | --- | --- | --- | --- | |  | |  |  | |  |  |  |  | | order | (1,18) | 5.63 | 0.029 | | env | (1,90) | 14.2 | <0.001 | | rank | (2,90) | 398 | <0.001 | | order:env | (1,90) | 5.90 | 0.017 | | order:rank | (2,90) | 11.1 | <0.001 | | env:rank | (2,90) | 18.0 | <0.001 | | order:env:rank | (2,90) | 3.97 | 0.022 | |  |  |  |  | |  |  |  |  | |  |  |  |  | | intercept | -0.173 | 0.246 | 0.483 | | reward(t) | 2.07 | 0.065 | <0.001 | | delay(t) | -2.05 | 0.066 | <0.001 | | reward(t-1) | -0.287 | 0.064 | <0.001 | | delay(t-1) | 0.071 | 0.064 | 0.265 | |  |  |  |  | |  |  |  |  | |  |  |  |  | | intercept | -1.51 | 0.296 | <0.001 | | reward | 4.74 | 0.151 | <0.001 | | pep | 0.334 | 0.132 | 0.011 | | delay | -4.66 | 0.151 | <0.001 | | env | 1.48 | 0.123 | <0.001 | | order | 1.13 | 0.398 | 0.005 | | trial\_index | -0.368 | 0.056 | <0.001 | | pep:reward | -0.200 | 0.132 | 0.128 | | pep:delay | 0.461 | 0.133 | <0.001 | |  |  |  |  | |  |  |  |  | |  |  |  |  | | intercept | -1.48 | 0.314 | <0.001 | | reward | 4.90 | 0.163 | <0.001 | | HR | -0.068 | 0.115 | 0.554 | | delay | -4.82 | 0.163 | <0.001 | | env | 1.46 | 0.122 | <0.001 | | order | 1.21 | 0.426 | 0.004 | | trial\_index | -0.415 | 0.055 | <0.001 | | HR:reward | 0.922 | 0.152 | <0.001 | | HR:delay | -0.703 | 0.152 | <0.001 | |  |  |  |  | |  |  |  |  | |  |  |  |  | | intercept | -0.236 | 0.334 | 0.481 | | value | 3.95 | 0.120 | <0.001 | | pep | 0.465 | 0.128 | <0.001 | | HR | -0.013 | 0.099 | 0.893 | | env | 0.607 | 0.113 | <0.001 | | order | -0.708 | 0.467 | 0.129 | | trial\_index | -0.344 | 0.056 | <0.001 | | pep:value | -0.188 | 0.112 | 0.092 | | HR:value | 0.718 | 0.108 | <0.001 | |  |  |  |  | |  |  |  |  | |  |  |  |  | | intercept | 0.030 | 0.005 | <0.001 | | d\_pep | -0.008 | 0.002 | <0.001 | | d\_HR | -0.002 | 0.002 | 0.438 | | choice | -0.017 | 0.005 | <0.001 | | trial\_index | -0.001 | 0.002 | 0.703 | | order | 0.003 | 0.005 | 0.491 | | env | -0.041 | 0.005 | <0.001 | | |  |  |
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**Analysis branch 3 - alternative time binning**

In Analysis branch 3 we observe evidence that sympathetic engagement during crucial learning periods of a low reward environment predicts optimal behavioral adjustment. We ran two iterations of a model of behaviour optimisation variable (see Analysis branch 3 methods), predicted by changes in PEP and HR during the first half (i.e. 0-360s) and second half (360-720s) of the blocks. Here we report a similar pattern of results, using an increased number of shorter time bins: quarter 1 (0-180s), quarter 2 (180-360s), quarter 3 (360-540s) and quarter 4 (540-720s). As summarized in the table below, only PEP approaches significance in the first two quarters, principally in the first.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | quarter1 | | quarter2 | | quarter3 | | quarter4 | |
|  |  |  |  |  |  |  |  |  |
| PEP | 0.268 (0.137) | 0.067 | 0.294 (0.155) | 0.074 | 0.294 (0.184) | 0.129 | 0.214 (0.152) | 0.177 |
| HR | 0.115 (0.177) | 0.525 | -0.456 (0.296) | 0.141 | -0.283 (0.285) | 0.336 | -0.008 (0.188) | 0.965 |